COURSE METHODOLOGY: STRUCTURE AND CONTENT OF THE MODULES

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CONTEXT

- Agricultural Systems and Environmental Threats: Current agricultural practices pose significant threats to climate stability, ecosystem resilience, and environmental health.

- Sustainability and Resilience: To counter these crises, enhancing agricultural sustainability and resilience is vital.

- Urgent Action for Greenhouse Gas Reduction: It is essential to fulfill the Paris Agreement's commitment to limit global warming to less than 1.5 or 2 °C above pre-industrial levels.

- UN Sustainable Development Goals (SDGs) Relevance: Several UN SDGs, including zero hunger, good health, responsible production, climate action, and life on land, are directly pertinent to sustainable agriculture.

CONTEXT

- EU's Ambitious Climate-Neutral Goal: The EU Commission aims to lead in climate neutrality by 2050 through the European Green Deal.

- Interconnectedness with EU Biodiversity Strategy: The EU Biodiversity Strategy, emphasizes goals of reintroducing resilient nature to agricultural landscapes, forests, seas, coasts, and urban areas.

- Shared Goals, Diverse Approaches: While EU member states are in consensus about the importance of these goals, the challenge lies in devising diverse, locally adaptable pathways to achieve them.

CONTEXT

+

10%
area under
high-diversity landscape features

SOLUTION

A solution exists: Regenerative Agriculture has the power to rejuvenate the natural harmony of our ecosystems, revitalizing landscapes for the well-being of future generations. The key lies within the soil itself.

Regenerative agriculture objectives:

- Maintain agricultural productivity
- Increase biodiversity
- Restore and sustain soil biodiversity
- Enhance ecosystem services, including carbon capture and storage

Approach:

- Regenerative agriculture is not confined by predetermined rules; it centers on setting achievement goals.
- Practices and technologies are adapted progressively to meet these objectives.
- It embraces modern advancements such as breeding tech, tilling, inorganic fertilizers, and pesticides, but with a focus on limited, targeted utilization.

THE COURSE IN REGENERATIVE AGRICULTURE: AMBITION

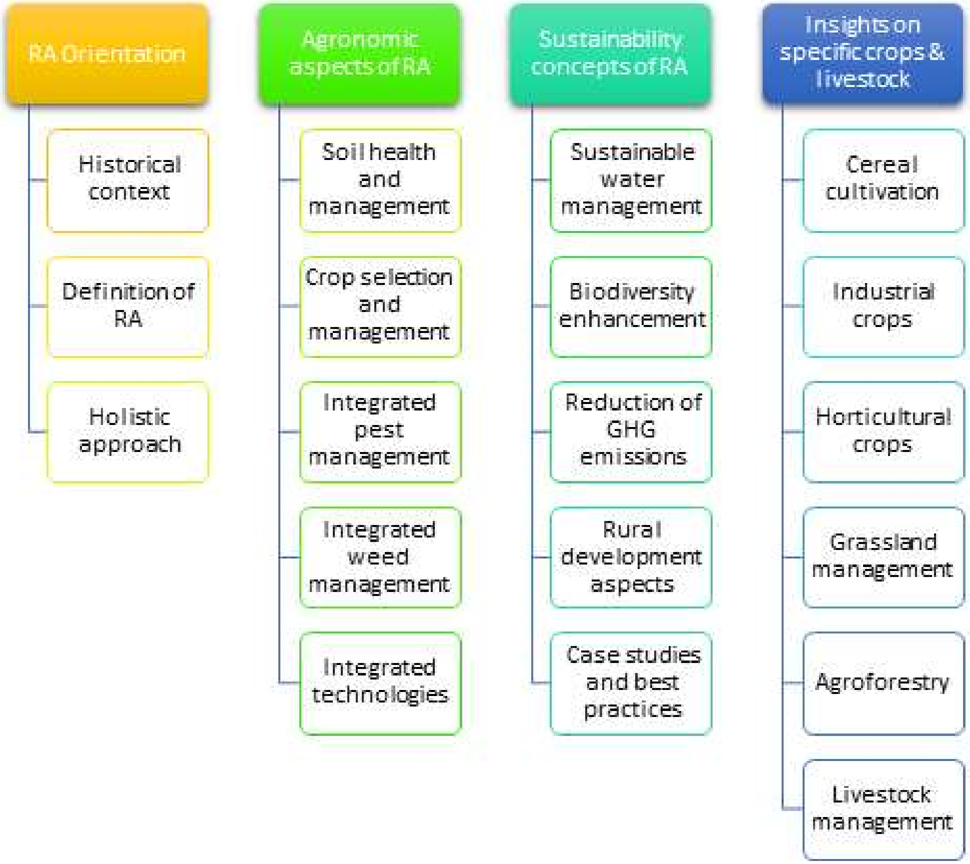
The Course in Regenerative Agriculture for Higher Education students.

The target groups of this course will be students in the disciplines of

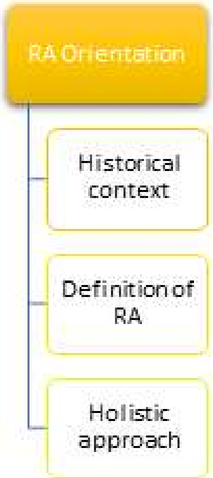
- Agricultural engineering, Agricultural sciences, Agronomy
- Environmental sciences, environmental engineering
- Crop production, grassland management, Animal breeding
- Soil science
- Sustainable rural development
- Regional planning
- Rural sociology

The course will equip students with skills and knowledge to promote RA as future farmers' and sustainable development advisors.

THE COURSE IN REGENERATIVE AGRICULTURE: SYLLABUS



INTRODUCTORY MODULE

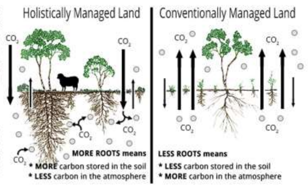


WHAT IS REGENERATIVE FARMING?

- A type of agriculture that aims to restore balance in ecological systems through a whole of farm approach.
- **Regenerative farming is characterized by a focus on:**
- Increasing biodiversity
- Maintaining groundcover
- Incorporation of farming systems into existing natural systems
- Increasing the organic matter in soils
- Monitoring the regeneration of the landscape
- Reducing reliance on inputs

WHAT IS HOLISM AND HOW ITS RELATES TO REGENERATIVE AGRICULTURE?

- The foundation of the concept of Holistic Management is the perception of nature as a complex whole, the parts of which are, without exception and at whatever level, all interconnected and interdependent. In this way, we all form part of a living community with a mutual vital relationship between people, plants, animals and the land.
- There are no individual stand-alone elements in nature; everything is intricately connected and if you remove or change the behaviour of any one of the key species it will have a wide-ranging effect on other parts of the ecosystem.



THE FREQUENCY OF RA KEY TERMS IN BOOKS

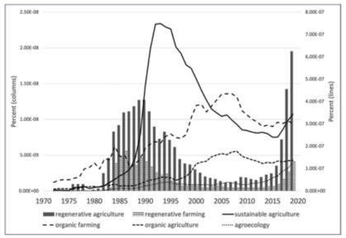
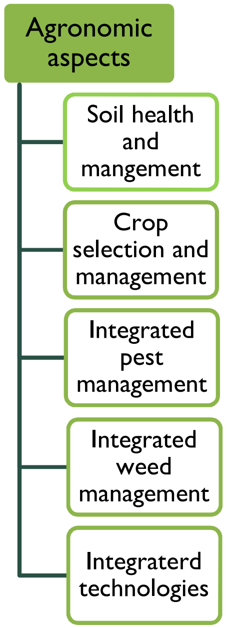


Figure 2. The frequency of key terms in books (3-year rolling averages). Source: Google NGram Viewer, Corpus 'English 2019' which includes books predominantly in the English language published in any country.

AGRONOMIC ASPECTS



Course Goals:

•Develop a strong foundation in soil health and its importance in RA

•Learn about crop selection and management techniques for RA

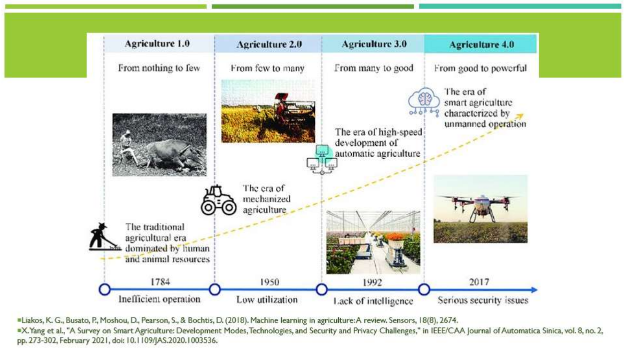
•Understand natural pest control methods and how they can be implemented in RA

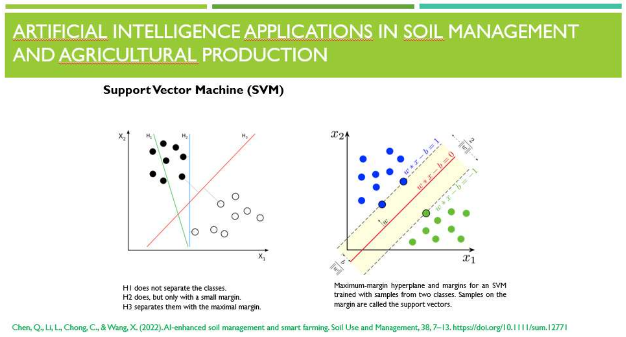
•Understand sustainable weed control methods

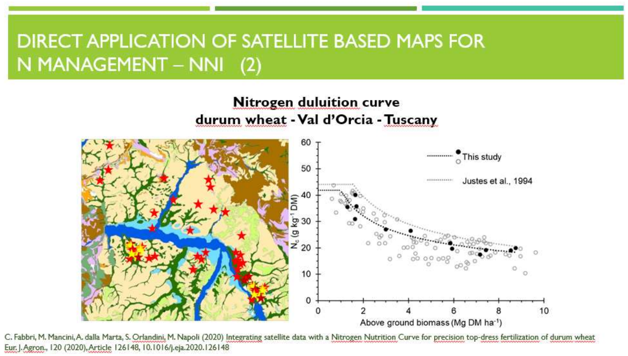
•Identify and evaluate different types of integrated technology (i.e. precision agriculture, data analytics) that can be used to improve crop management and reduce environmental impact.

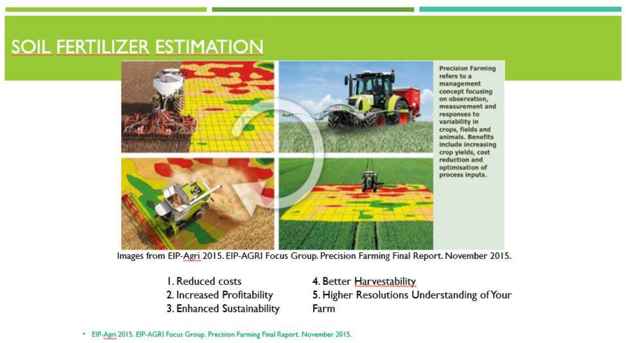
AGRONOMIC ASPECTS - INTEGRATED TECHNOLOGIES

- Agronomic aspects
  - Soil health and mangement
  - Crop selection and management
  - Integrated pest management
  - Integrated weed management
  - Integrated technologies









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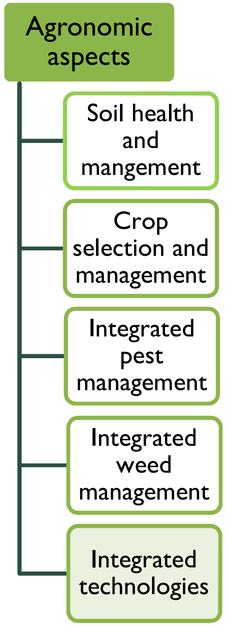
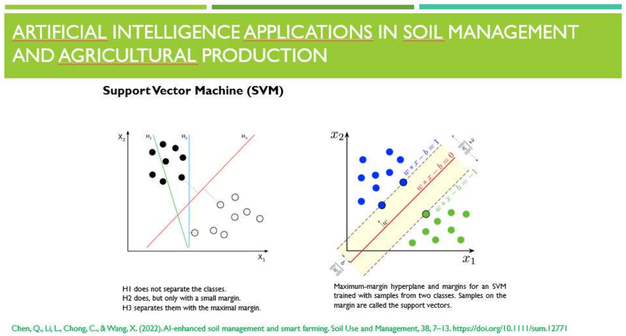




Slide - Support Vector Machine

Support Vector Machine is a supervised algorithm for regression and classification. Since most datasets are not linearly separable, the general SVM can allow misclassified examples, but penalties have to be paid. The objective of SVM is to construct a hyperplane to distinct positive and negative data sets. It provides binary decisions to support classification. The intuition is to attain the maximum margin, which is to maximize the distance between hyperplane and data sets.

As regard the Pros and Cons associated with Support Vector Machine

Pros:

It works really well with a clear margin of separation

It is effective in high dimensional spaces.

It is effective in cases where the number of dimensions is greater than the number of samples.

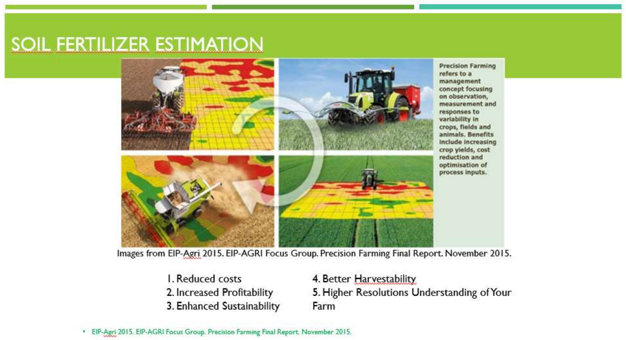
It uses a subset of training points in the decision function (called support vectors), so it is also memory efficient.

Cons:

It doesn't perform well when we have large data set because the required training time is higher

It also doesn't perform very well, when the data set has more noise i.e. target classes are overlapping

SVM doesn't directly provide probability estimates, these are calculated using an time-consuming k-fold cross-validation.



Slide - Soil fertilizer estimation

Precision fertilization represents an important component of precision agriculture technology; the basic concept is to use GPS to segment the field into grids, then check for soil nutrients and measure the required fertilizer input by using the fertilization model and fertilize based on a variable rate applicator. Practical experience shows that precise fertilization can minimize the use of fertilizers, improve crop production, balance nutrients in the soil, and minimize emissions in the atmosphere.

Being able to accurately decrease fertilizer rates in areas where it will not be economical to utilize is one of the key benefits of precision fertilization.

Increasing yields because of applying agronomic principles at a high resolution, while reducing costs increases overall profitability. Farmers Edge offers one of the lowest-priced, high-value packages in the industry through our unique application of technology.

Ensuring that crop input products applied actually get into the plant and not elsewhere affecting the environment delivers not only a superior bottom line but also supports a safer environment, and in the future, can even give you access to new markets for your crops.

One of the most significant benefits of precision agriculture is the ability to understand the farm nutrient levels and soil types across the farm. We know that fields and geographies are not created equal, and this can impact the amount of nitrogen mineralization, water holding capacity, and much more. When we understand these variances, we can ensure we do not over apply nitrogen, which can lead to lodging, or we can increase nutrients like potassium that help with standability in areas where it is low.

Farmers know their land better than anyone. Precision agriculture gives you the ability to understand why certain areas of your farm under produce, or are producing better, giving you the foundation to make decisions that continually improve the farm.

AGRONOMIC ASPECTS - INTEGRATED TECHNOLOGIES

- Agronomic aspects
  - Soil health and mangement
  - Crop selection and management
  - Integrated pest management
  - Integrated weed management
  - Integrated technologies

AGRONOMIC ASPECTS - SOIL HEALTH AND MANAGEMENT

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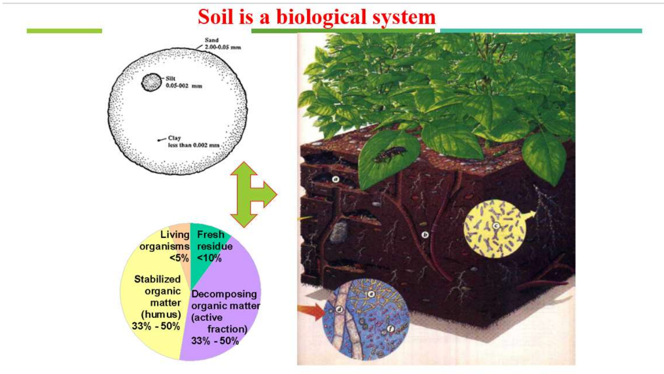
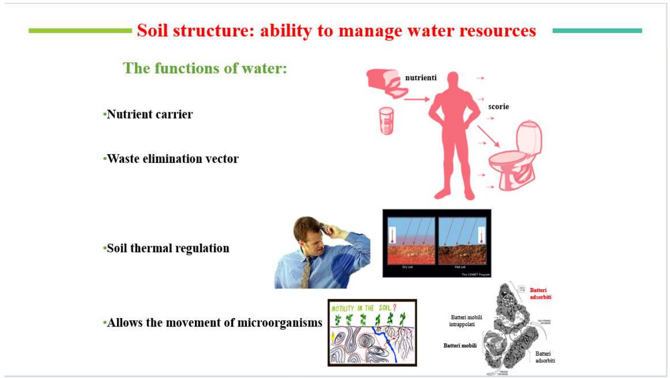
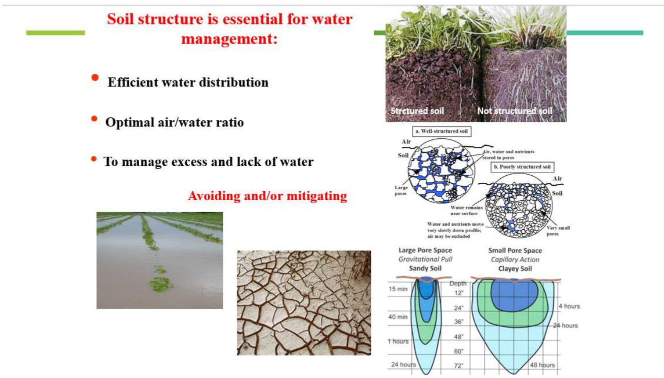
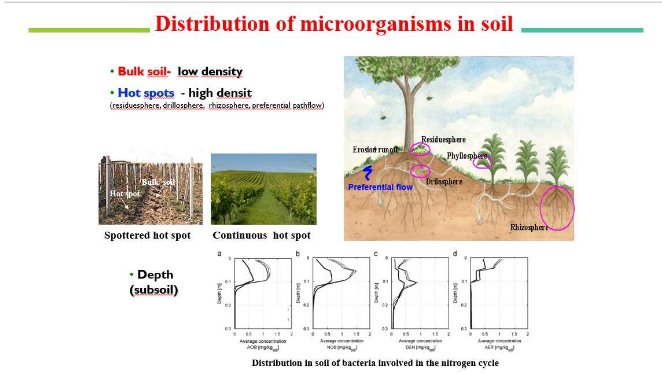
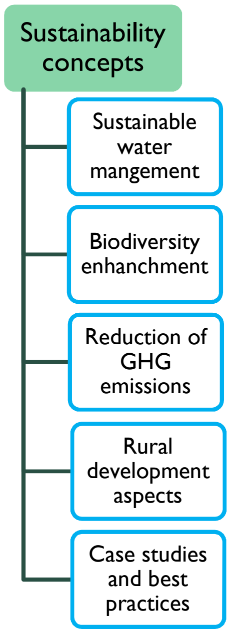








SUSTAINABILITY CONCEPTS



Course Goals:

•To understand the principles and practices of RA and its relationship to sustainability.

•To identify the key factors that contribute to the sustainability of RA.

•Challenges and opportunities in promoting sustainable agriculture from a policy and economics perspective.

•Effectiveness of different sustainability practices in RA.

•To develop practical skills for implementing sustainable agriculture practices in personal and professional contexts.

•To analyze case studies of successful RA systems and apply principles to real-world scenarios.

•To understand the role of community development in promoting sustainable agriculture.

•Discussion and critique of sustainability concepts and practices in regenerative agriculture.

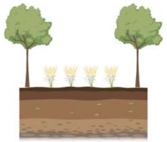
SUSTAINABILITY CONCEPTS – BIODIVERSITY ENHANCHEMENTS

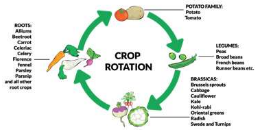
- Sustainability concepts
  - Sustainable water mangement
  - Biodiversity enhanchment
  - Reduction of GHG emissions
  - Rural development aspects
  - Case studies and best practices

BIODIVERSITY IN AGRICULTURE

Biodiversity in space
- Intercropping
- Agroforestry

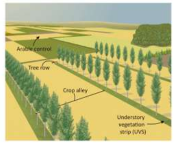
Biodiversity in time
- Crop rotation





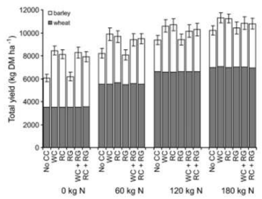
BIODIVERSITY IN SPACE

Agroforestry
- Silvoarable system: Combination of trees and arable crops cultivation on the same land
- Silvopastoral system: Combination of trees and livestock of the same land



BIODIVERSITY IN SPACE

Intercropping: cereal-legume mixture
- Two-years field trials in 2 locations
- Four nitrogen level were compared (0, 60, 120, 180 kg N ha⁻¹)
- White clover (WC), Red clover (RC), perennial ryegrass (RG), and some mixtures (WC+RG and RC+RG) were under-sown (relay cropping) in winter wheat compared to a no sown (no CC) control
- The effect was also assessed for the next crop (barley)



Bergkvist et al. (2011)

BIODIVERSITY IN ECOLOGY

- Number of living species that are present in a specific place (ecological definition)

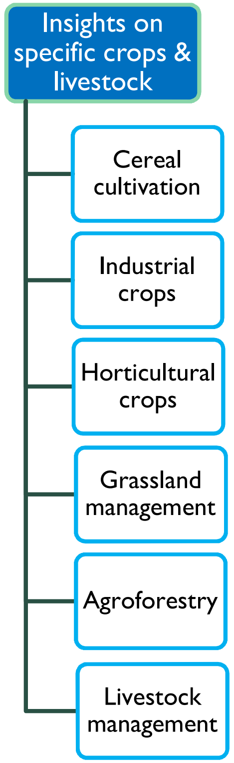
Ecology, 90(12), 2009, pp. 3290–3302
© 2009 by the Ecological Society of America

Does this apply to agriculture?

Plant species richness and functional composition drive overyielding in a six-year grassland experiment

Elisabeth Marquard,[1,2,6] Alexandra Weigelt,[3] Vicky M. Temperton,[1,7] Christiane Roscher,[1] Jens Schumacher,[1,8] Nina Buchmann,[4] Markus Fischer,[5] Wolfgang W. Weisser,[3] and Bernhard Schmid[2]

INSIGHTS ON SPECIFIC CROPS & LIVESTOCK



Course goals:
To provide students with a comprehensive understanding of RA and its principles, as well as the unique benefits it can offer to specific crops and livestock.

To educate students on the different types of crops and livestock

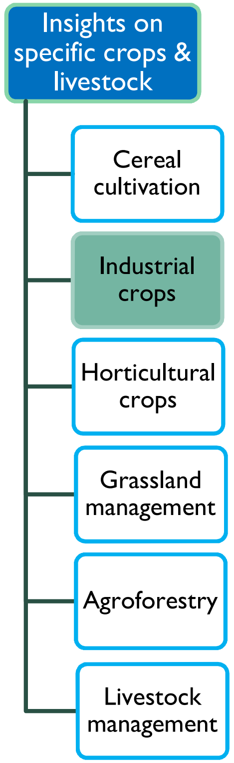
To teach students the various RA practices used in crop production

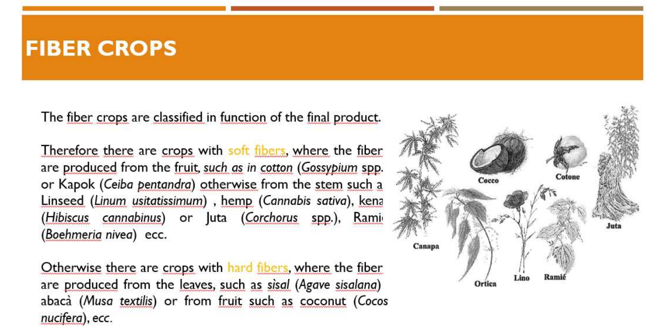
To educate students on the importance of soil health and its role in Ra

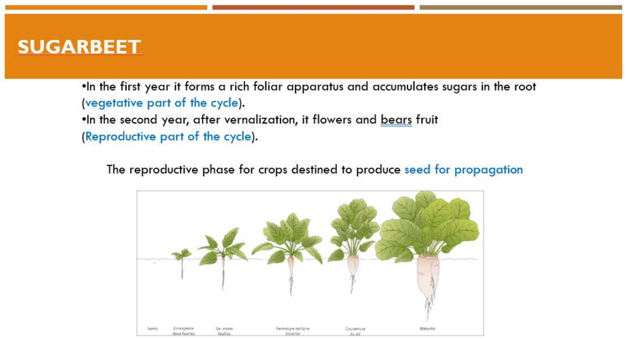
To provide students with the knowledge and skills necessary to design and implement a RA system, including the use of livestock as an integral component of a sustainable farming

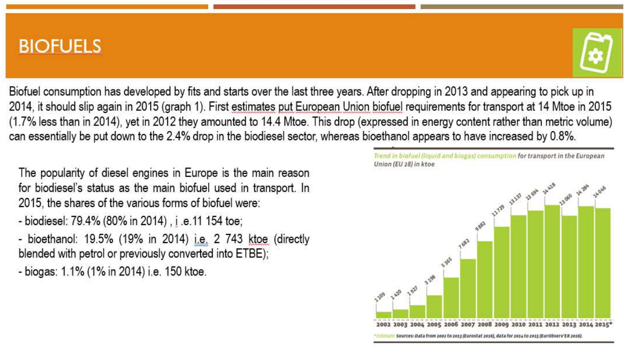
To instill in students an appreciation for the importance of sustainable agriculture practices and their potential to benefit the environment, local communities, and the economy.

INSIGHTS ON SPECIFIC CROPS & LIVESTOCK – INDUSTRIAL CROPS









FIELD VISITS – HORIZONTAL MODULE

THANKS FOR YOUR ATTENTION

Regenerative agriculture. An innovative approach towards mitigation of climate change through multi-tier learning

The REGINA project (No. 2021-1-HU01-KA220-HED-000027629) was funded by the European Commission. The content of this publication does not necessarily reflect the views of the European Commission.
Call 2021, KA220-HED – Cooperation Partnerships in Higher Education

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